



United States Department of Agriculture

**Office of the Chief Information Officer
Telecommunications Services and Operations
Network Engineering Division**

Telecommunications Enterprise Network Design

Volume One

Project Executive Summary

Version 1.0 June 30, 1998

THE VISION

“With the telecommunications architecture as a guide, the existing Departmental and Agency networks will evolve to become the USDA Enterprise Network, a completely integrated and efficient telecommunications utility.”

—Anne Reed, Chief Information Officer

THE CHALLENGE

Develop Department-wide information and technical infrastructures that will improve service delivery through more effective information systems and data management.

—OCIO Strategic Plan, Goal 2.0

THE MANDATE

Design and implement a USDA Telecommunications Enterprise Network.

—OCIO Action Plan, Objective 2.2

Acknowledgements

*"Our team consists of Department, Agency, and contractor personnel,
each bringing their unique set of skills and experiences ..."*

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Contractor Support Provided By:

Make Systems, Inc.
Performance Engineering Corporation
Pilot Research Associates, Inc.
Planning Technologies, Inc.

PROJECT EXECUTIVE SUMMARY – PROJECT VOLUME ONE

This document is a concise presentation of the reports generated for the initial Telecommunications Enterprise Network (TEN) Design Project. The presentation of the document summaries follows the order of the unabridged documents presented in the Project Summary Report ([Project Volume Two](#)). This order is the logical sequence of network design activities – planning, baseline measurement, development/selection of alternative designs including financial analysis ([Project Volume Three](#)), and design project validation ([Project Volume Four](#)). The Implementation Phase of the TEN Project will be presented in a separate document series.

ISTA Part III – Telecommunications Architecture: Telecommunications Security Architecture

This presentation of the Information Systems Technology Architecture (ISTA) includes the USDA Network Security requirements, structure, and standards.

Best Network Security Practices

The current state of network security technology is presented with a discussion of positive and negative aspects of technology alternatives.

Network Security: Implementation

Important issues required for implementing network security policy are presented and evaluated.

Enterprise Network Operations Center: Concept of Operations

The operation of the proposed USDA ENOC is defined by five categories: Fault, Configuration, Performance, Accounting, and Security Management.

Physical Baseline Definition of USDA Data Networks

The Physical Baseline Definition reports the identification of USDA Data Networks existing equipment and its interconnection.

Network Level Traffic Study

The Network Level Traffic Study describes the amount of data traffic on the existing network interconnections.

Comprehensive Network Baseline Analysis

Using a standardized design approach, the report describes the current USDA Data Networks in terms of network utilization, services, and topology.

Application Level Traffic Study

The type and volume of Network Applications used by USDA Agencies are measured and used for evaluation of network performance and survivability.

Development of Networks Capacity Design

The Network Capacity Study provides recommendations to reduce costs and to improve performance and utilization.

Development of Alternate Network Designs

The TEN Design Project culminates with development of three alternate designs sufficient for USDA Management to determine the direction to follow in implementing an Enterprise Network.

TEN Economic Analysis

A financial analysis of the TEN Project provides management a cost basis for selecting between TEN Design Alternatives.

Independent Verification and Validation (IV & V) of the TEN Project

The IV & V report provides an independent project management review of the TEN Project.

Planning

*Baseline
Measurement*

*Design
Alternatives*

*Project
Validation*

The central theme of the USDA Telecommunications Architecture is the TEN, a unified, standards-based telecommunications infrastructure that services all USDA agencies and organizations. Agency controlled local area networks (LANs) continue to allow optimum work effort for the bulk of an organization's activities. For Department-wide communication, the TEN provides fast, economical, standardized access.

The TEN Project consists of design and implementation phases. The documents in the Project Executive Summary (Project Volume One) and the Project Summary Report (Project Volume Two) report the results of studies by teams of the Network Engineering Division. The objectives were to define the current USDA Data Networks, provide USDA Management with improved, cost-effective alternative designs based on an enterprise network system, and to prepare specifications and procedures for the initial implementation and operation of the network. Key project results are grouped by subject matter but individual results may have come from any of the design studies.

KEY PROJECT RESULTS

Baseline Physical Description

- The physical description of the existing USDA Data Networks (June 5, 1998) includes 921 routers, 887 DTS WAN links and 395 frame relay POPS. USDA network routers are predominately Cisco (94%). The logical description of the network topology is a complex "hub-and-spoke" design.
- USDA Network router software is out-of-date. Only 13% of the USDA routers use software that is fully supported by the Vendor.
- City-to-city optimization, without WAN re-engineering, causes problems in network capacity, performance, and reliability. Most USDA Data Network topologies are Agency specific, with network configurations converging on central locations. This configuration does not effectively support shared agency connections.

Baseline Network Usage

- USDA Data Networks are underutilized. On an "average" day nearly 80% of the circuits are used at less than 10% of theoretical capacity.
- Based on average and peak utilization information, 100% of the measured USDA Data Network links are, to some degree, incorrectly sized.
- Approximately 84% of the measured USDA Data Network links have an average usage at less than 15% of the theoretical link capacity and represent links on which cost can be reduced.
- Approximately 16% of the existing USDA Data Network links have an average usage greater than 50% of theoretical capacity and require timely attention to avoid an impact on mission performance (i.e. 4% are used at >70%, requiring immediate attention).
- The predominant use of the current USDA Data Networks is World Wide Web browsing on the Internet.

- USDA Data Center traffic is currently not a large percentage of the existing IP networks traffic.
- The Baseline Study reveals that most Agency services are independently contracted. Development of the Initial Enterprise Network consolidates network services contracting and thus provides benefits from economy of scale. Benefits of pooled resources include reduced cost, better performance, and better reliability.

Baseline Network Cost

- A Network Cost Metric was established for existing USDA Data Networks. The Metric relates recurring monthly service and equipment maintenance costs as well as amortized capital equipment costs. Eighty percent of the total is recurring Monthly Cost of Services.
- Downgrading (reducing bandwidth) of underutilized network links can potentially reduce USDA service cost by as much as 23%.
- Upgrading (increasing bandwidth) of over-utilized network links can improve service performance for several USDA Agencies.

Baseline Network Performance

- Performance on the USDA Data Network is generally poor due to constraints imposed by existing design topologies.
- Survivability of the current USDA Data Networks is poor due to constraints of the existing design topologies.

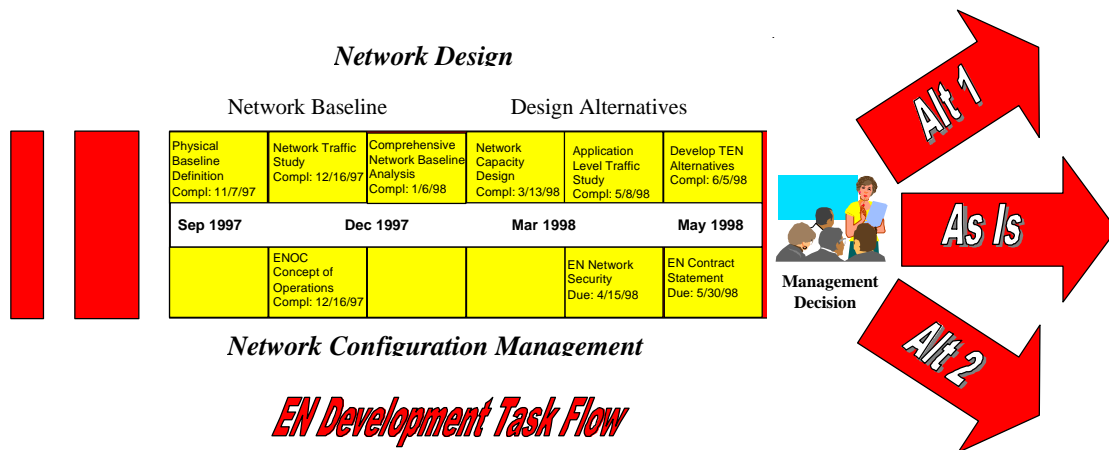
Alternative Designs

- There is now a sufficient description of the present USDA Data Networks available to design TEN alternatives for management evaluation.
- The TEN baseline description indicates that the USDA Data Networks can be significantly improved by a redesign of the existing networks using a more robust design strategy.
- All Design Alternatives perform better than the current USDA Data Network.
- Redesign of the combined USDA Networks will have the biggest impact on cost.
- The Network Baseline monthly cost can be significantly reduced by as much as 47% with the new designs.
- Alternative Network Designs can reduce active bandwidth 98% while bandwidth utilization is doubled.
- A USDA TEN, offering high performance, survivability, and cost efficiency is an obtainable goal using the USDA Network Design Process.
- Network architecture and design is a continuing function of managing a telecommunications program. New service requirements, technology innovation, or simply organizational changes require monitoring and refinement of the architecture.

ACTIONS REQUIRED

The information provided by the Network Engineering Division represents sufficient technical information for USDA Senior Management to:

- select one of the three TEN Design Alternatives or order a new design alternative based on recommended constraints, and
- assume a highly visible leadership role to promote the USDA TEN implementation.



1.0 Project History

The pursuit for a United States Department of Agriculture (USDA) Telecommunications Enterprise Network (TEN) is marked by responses to various mandates and studies. The *1993 USDA Strategic Telecommunications Plan* (STP) expressed the USDA's intent to: combine telecommunications networks into an enterprise network configuration and to operate the network cost-effectively. In the Fall of 1995, the USDA's Office of Information Resources Management began action on those STP initiatives directly associated with EN implementation. Motivation for this activity included:

- the USDA reorganization resulting from October 1994 legislation;
- the implementation of several information resource management initiatives requiring improved telecommunications services;
- Congress expressed expectations for increased internal coordination and efficiency from all IRM resources;
- A life-cycle approach for modernizing, operating, and managing USDA telecommunications resources was articulated in the USDA Telecommunications Program Plan and implemented in 1995.
- In November 1995, the USDA launched the IRM Modernization Program for using integration and cooperation to improve IRM throughout the USDA.

In 1995, USDA telecommunications was the focus of probes by the Government Accounting Office (GAO AIMD-95-203). The state of USDA telecommunications networks was described as "not cost-effectively managed", "using unnecessary telecommunications services and equipment", and "not effectively planned" with "costly new agency networks that overlap and do not support interagency information sharing".

Most recently the USDA Office of the Chief Information Officer (OCIO) has positioned the TEN as the foundation for a modernized information resources management (IRM) infrastructure. This infrastructure enables the Department to realize the service goals and business processes set forth in the early mandates. Earlier efforts to establish a USDA TEN were incomplete. Significant departures from earlier efforts to realize a TEN are:

- the creation of the Network Engineering Division divided into two teams, the Network Architecture and Design Team and the Network Configuration Management Team, composed of staff from OCIO and several agencies on assignment to the project, as well as contract support.
- the use of a standardized network analysis process predicated on the known complexity of the existing USDA network and state-of-the-art network tools used to characterize the current network.

- through modeling, design efficient, high performance, high quality network alternatives;
- the understanding for the need to have parallel development of TEN configuration management practices in accordance with USDA policy and Agency requirements. Network configuration management provides for the long-term operation, security, and stability of the finished TEN.

The success of the TEN Teams is a direct result of its composition and management which provides detailed knowledge of the various agencies, agency liaison, and complementary experience. The use of a standardized process and modern design tools establishes credibility through objective, uniformly applied analysis and design.

2.0 Background

The mission programs of USDA Agencies are a diverse set of agriculture, forestry, rural development, aquaculture, human nutrition, and research programs that require substantial telecommunications resources. Success of Agency mission programs is measured in terms of information availability - the right time, the right place, and the right customer. The solution is a systematically engineered Telecommunications Enterprise Network (TEN), conceptualized in Fig. 1, based on USDA business requirements, customer service, and cost efficiency.

2.1 Information Systems Technology Architecture

The USDA Information Systems Technology Architecture (ISTA) represents a coherent plan facilitating informed decision-making regarding technology and services needed to support business objectives. The ISTA relies on institutional processes and policies to identify, describe, and validate the business objectives of the USDA. The ISTA consists of three parts: Business/Data Architecture, Technical Architecture, and the Telecommunications Architecture. Together, the three parts of the ISTA address information technology infrastructure, descriptive information about USDA information environment, and information technology standards.

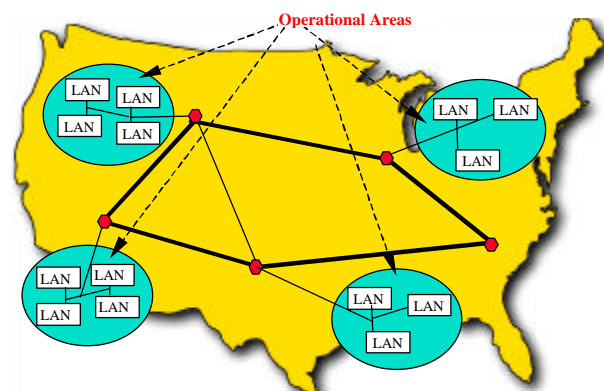


Figure 1 Enterprise Network Conceptual Design

2.2 Telecommunications Network Stabilization and Migration Program

The April 1997 Telecommunications Network Stabilization and Migration Program (TNSMP) establishes a plan for the development of a USDA Telecommunications Enterprise Network. The TNSMP is divided into two operational phases. Phase I is designed to stabilize the current telecommunications environment while providing processes and procedures to enable planning, acquisition, and management of USDA Telecommunications assets. Phase II of the TNSMP addresses the details and processes for USDA migration to a cost effective, coordinated and documented USDA Telecommunications Enterprise Network serving all Agencies. Implementation of TNSMP Phase II is described in the TNSMP Plan. An overview of the TNSMP is presented in Figure 2. Another significant mandate of the TNSMP is the development and implementation of a network design process which produces a design for a USDA network satisfying the connectivity needs of USDA systems, processes and users in the most cost effective manner.

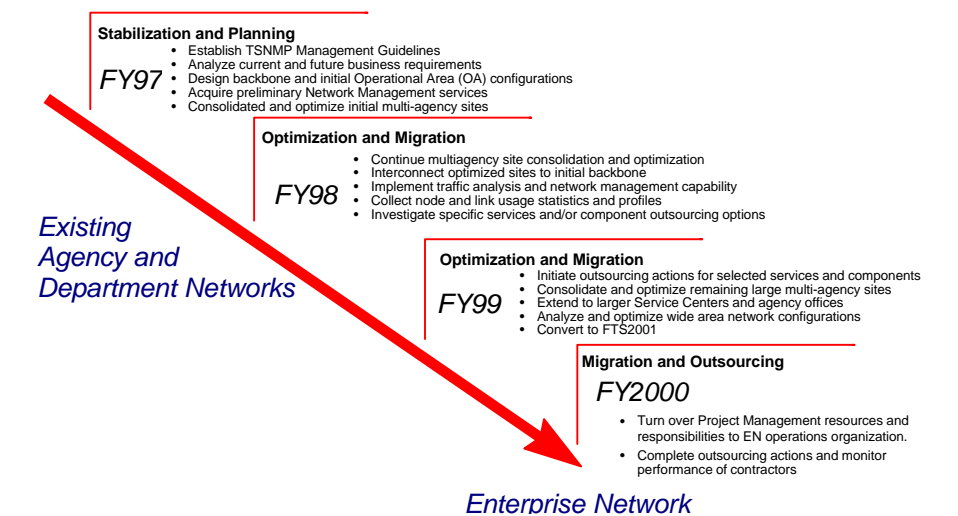


Figure 2 Telecommunications Network Stabilization and Migration Program

2.3 TNSMP Plan

The October 1, 1997 TNSMP Plan (Program Plan) describes the approach that the OCIO is taking to implement the TNSMP. The Program Plan approach is logical and cost effective. It provides near-term resolution of current operating issues and immediate cost savings while creating a straight-forward path to the USDA TEN. The Program Plan proposes six initiatives which, upon completion, result in a fully operational TEN.

2.4 Geographic Network Analysis Process

A common thread linking all aspects of the USDA Telecommunications Planning Processes is standardization. Standardization promotes cost efficiency by optimizing the selection and procurement of telecommunications services and equipment. The USDA recognizes the need for a network design process applied uniformly throughout the Department while also being sensitive to Agency specific missions. The USDA Geographic Network Analysis Process (GNAP) is technically sound, flexible and adaptable to emerging technologies and their inherent economics.

The USDA GNAP (Fig. 3) is divided into four parts:

- Data Collection
- Modeling
- Optimization
- Design Alternatives

The standardized process is a general design tool used for developing the TEN as well as designing all future changes.

2.5 Analysis and Design Tools

Prior to initiating the TNSMP Plan, the Network Engineering Division established a set of criteria considered necessary and sufficient for selecting a design tool to help make the new TEN compliant with USDA expectations and requirements. The network tool was expected to:

- insure that the USDA Network had the appropriate capacity to meet mission requirements;
- help avoid unplanned configuration changes that may be costly to the network operator;
- permit the system professional to run “what if” scenarios.

Tool evaluation criteria were applied to two dozen tools available in the marketplace. The result of the evaluation led to the use of the NetMaker XA[®] system by Make Systems, Inc.

NetMaker XA[®] is composed of several tools that, applied individually and collectively, provide the NED with the capability to evaluate the existing data

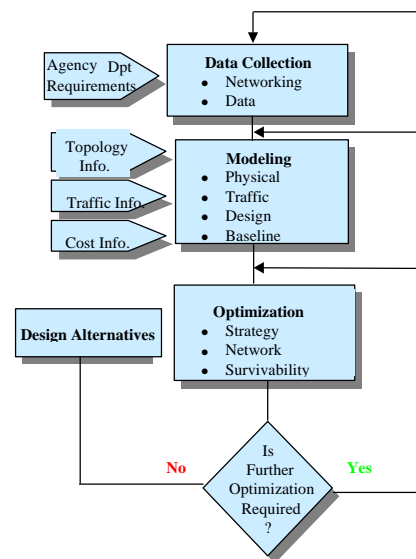


Figure 3 Flowchart of Network Design Process

networks and create design alternatives, whether the designs be for the USDA TEN or future changes to the TEN. The NetMaker XA[®] tools include:

- Accountant – This feature of NetMaker XA[®] is used to help network administrators determine the least-cost providers of bandwidth; allocate bandwidth and equipment costs among network users.
- Planner – The Planner feature of NetMaker XA[®] allows assessment of network capacity; evaluation of network loading and resource usage, planning capacity requirements, evaluation of adding/removing hardware and facilities, determination of optimal route paths/invalid routes and assessment of network delays.
- Interpreter – This feature of NetMaker XA[®] is a graphical traffic analysis tool designed to work in conjunction with traffic monitoring and capturing tools such as LAN monitors.
- Designer – The Designer feature addresses a broad range of planning tasks. This is the key tool for automating the process of creating acceptable TEN design alternatives.

2.6 Telecommunications Architecture

The USDA ISTA describes the guidelines for the Agriculture Department to achieve the objectives of the 1993 Government Performance and Results Act (GPRA). The Telecommunications Architecture, part three of the ISTA, provides the framework for managing the efficient use and continued evolution of telecommunications services, systems, and networks in performing the Department's missions in a cost effective manner.

The cornerstone of the Telecommunications Architecture is the development of a USDA TEN. The project development responsibilities of the Network Engineering Division mandated by the Telecommunications Architecture include planning, analysis, design, and management.

3.0 TEN Development

3.1 TEN Project Teams

Responsibility for development and design of a TEN belongs to the Office of the Chief Information Officer through the Network Engineering Division of the Telecommunications Services and Operations Organization. The Network Engineering Division is functionally divided into two teams: the Network Architecture and Design Team and the Configuration Management Team. Both teams are composed of OCIO staff, personnel on loan from other USDA Agencies, and various contract support staff.

The Network Architecture and Design Team is responsible for 1) describing the existing USDA Data Networks to provide a baseline of reference for evaluating new designs and 2) creating alternative network designs in the form of an enterprise network for improving performance, survivability, and cost of USDA information systems. Describing a USDA network baseline was accomplished through the use of a standard network design process to complete four tasks: Physical Baseline Definition – Task I., Network Level Traffic Study – Task II, and Comprehensive Network Baseline Analysis – Task III, and Application Level Traffic Study – Task V. Creating TEN design alternatives proceeded through: Development of a Network Capacity Design – Task IV, and Development of Alternate Designs – Task VI.

The Configuration Management Team responsibilities included elaboration of the Telecommunications Architecture, evaluation of current network security technology and its implementation, and establishing the principles for managing, operating and maintaining a TEN. Network security projects included the Network Security Architecture, section five of the Telecommunications Architecture and the evaluation of security technology through studies for Best Network Security Practices and Network Security: Implementation. Projects to assure TEN operation included the ENOC: Concepts of Operation and the ENOC Statement of Work for eliciting and evaluating contractor proposals to operate the final USDA TEN.

3.2 Project Timelines

Objective 2.2 of the OCIO Strategic Plan is to “design and implement a USDA TEN”—the date proposed is September 2002. Toward this timeline, the project completion record of the Network Engineering Division is shown in Table 1. Specific sub-projects show a slippage of 2-3 months. The best analysis attributes the discrepancy to resource (personnel) changes and unanticipated equipment problems. Although the overall effect of the slippage on the project is predictable, there is no reason to suggest that all deliverables are equally affected. For example, it is fully anticipated that implementation of the ENOC can occur in October 1998 as scheduled.

Implementation of the TEN, the next logical phase of the project following management approval, involves establishing the ENOC, refining and initiating management selected network design, and transitioning these functions to operational organization of the USDA. Detailed project planning for the implementation phase is now in progress. Implementation and transition, as initially proposed, follows the FTS2001 transition process and schedule. Operational organizations responsible for the functional TEN are the Business Services and Network Services Divisions, Office of the Chief Information Officer, Telecommunication Services and Operations.

TELECOMMUNICATIONS ENTERPRISE NETWORK DESIGN

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Project Deliverable	Scheduled Completion	Actual Completion
Prepared physical data network baseline report	November 1997	November 1997
Develop network level traffic study report	December 1997	December 1997
Develop comprehensive network baseline analysis report	December 1997	December 1997
Prepare Enterprise Network Concept of Operations document	December 1997	December 1997
Prepare USDA Network Security Architecture Document	January 1998	April 1998
Develop current network capacity recommendations	January 1998	March 1998
Conduct applications level traffic study	February 1998	March 1998
Develop initial Data Enterprise Network design alternatives	April 1998	June 1998
Develop Data Enterprise Network Contract Statement of Work	April 1998	May 1998
Implement Enterprise Network Operations Center (ENOC)	October 1998	

Table 1 TEN Project Schedule

3.3 TEN Planning

3.3.1 Security Architecture

Network Security encompasses the programs, procedures, equipment, and jobs that insure the integrity of Department information.

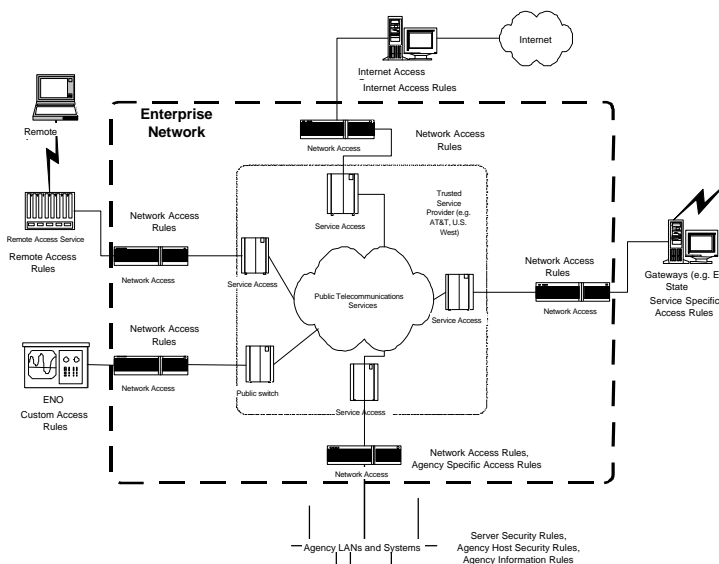


Figure 4 Enterprise Network Security Architecture

The Telecommunications Security Architecture (TSA) is intended to be an integral part of the *USDA Information Systems Technology Architecture (ISTA) - Part III, Telecommunications Architecture*. The document describes the rules, roles, and responsibilities for telecommunications security within the framework of the ISTA.

The Telecommunications Security Architecture (Fig. 4) defines the security requirements of an

Enterprise Network and adheres to the International Organization for Standardization (ISO) – Open Systems Interconnection (OSI) Reference Model for telecommunications networks

3.3.2 Best Network Security Practices

Best Network Security Practices (Pilot Research Associates, Inc.) is an information/reference document. It provides an overview of telecommunications network security requirements, current technology in addition to security implementation and management. Consistent with the current trend of “benchmarking” successful programs, Best Network Security Practices describes the pros and cons of successful security programs.

Network Security is divided into three basic categories: Security Requirements and Solutions, Security Management and Implementation, and Security Technology. The discussion of network security requirements is fairly complete and helpful for a security introduction. Security management and implementation covers Risk Analysis and basic security awareness procedures. Security Policy recommendations are logically organized into network, services, and data security. Security Technology discusses the various technologies used for network security

3.3.3 Network Security: Implementation

Network Security: Implementation is another document prepared by Pilot Research Associates for the USDA. The document purports to present critical security-related issues that must be considered when implementing a network security program.

The network security issues discussed include: Remote Access, Virtual Private Networks, Packet Filtering, High Availability concepts, Firewalls, and Policies. Of the issues presented, Remote Access, Firewalls, and Security Policy are most pragmatic and helpful.

3.3.4 ENOC Concept of Operations

TEN operation is the responsibility of an Enterprise Network Operations Center. The Enterprise Network Operations Center is managed by USDA approved contractors with oversight provided by the Architecture and Design Team and the Configuration Management Team of the Office of the Chief Information Officer, Telecommunications Services and Operations, Network Engineering Division.

The Concept of Operations document provides guidelines for ENOC operation and maintenance requirements. Enterprise Network Operations Center management responsibilities include Fault Management, Configuration Management, Performance Management, Accounting Management, and Security Management. This report defines the various responsibilities and describes the functional relationships between the Enterprise Network Operations Center and the other pertinent organizations. It depicts the Enterprise Network Operations Center interaction with the Architecture and Design Team, the Business Services and the Telecommunications Ordering, Billing, and Inventory process, and the Network Services offerings.

3.4 TEN Baseline Measurement

3.4.1 Physical Baseline Definition of USDA Data Networks

Objective – The goal of *the Physical Baseline Definition of USDA Data Networks* is the descriptive inventory of network hardware – routers, LANs, frame relay points-of-presence (POPs) – and transmission connections – router to LANs, WANs, and services.

Rationale – In order to suggest improvements for USDA Data Networks, it is necessary to understand how the current USDA network is assembled. Creating an inventory of network components permits assessment of features such as equipment technology level, software revision status, adequacy of the number and type of equipment as related to topology. Finding a physical inventory of old routers, outdated software, and inefficient topology would immediately suggest areas for improvement. Similarly, finding new equipment and well-planned, complementary topologies would mean other network aspects need to be considered possible areas for improvement.

Concept of Methods – Describing the physical components of the USDA Data Networks is made possible by “electronically asking” all of the network components to identify themselves. Equipment identity (name, location, node etc.) is stored in a Management Information (data)Base (MIB). By using sophisticated electronic equipment, it is possible to access the MIB and read the information.

There are, however, some limitations to the process. The equipment identity (and configuration) is actually entered into the MIB by humans. If the identity of the equipment is incorrectly entered, the identification reflects the erroneous information, skewing the results.

Results – The results of the physical baseline study include a preliminary physical inventory as of June 5, 1998.

Quantity of Equipment

Number of routers	927
Number of DTS WAN links	887
Number of Frame Relay POPs	395

Type of Equipment – Most routers are Cisco brand. (Fig. 5)

Network Topology – Mixture of Agency-based topographies, mostly of the Hub-and-Spoke configuration.

Eclectic – *In addition, results demonstrate the overall proof-of-principle for the analysis process.*

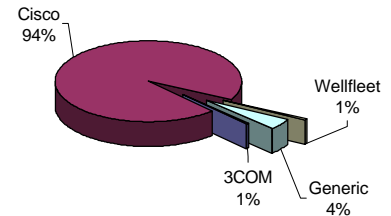


Figure 5 Distribution of Router Types

3.4.2 Network Level Traffic Study of USDA Data Networks

Objective – The Traffic Study describes how much the USDA Data Networks are used.

Rationale – To understand the current USDA Data Networks, the equipment inventory (Task I) must be supplemented with how the equipment is used. Some USDA Agency missions require very fast response to customers and some require transferring large volumes of information. The Traffic Study provides information to suggest whether network links are appropriate to the Agency's requirements.

Concept of Methods – In addition to storing identity data, telecommunications equipment collects data on how it is being used. Using the NetMaker XA[®] tool, network equipment is “queried” about its use during certain periods of time. Since there are over 900 routers on the USDA Data Network, it is possible to statistically sample equipment to derive a “snapshot” of utilization.

Results – For the most part, USDA Data Network links are used much less than their capability.

“Average” Day Usage = 5.4% of theoretical capability

“High” Day Usage = 25.5% of theoretical capability

Important: Clearly the results suggest opportunities for cost savings by consolidation. However, results are averages of statistical samples

and do not make it obvious that some links are actually over used and need upgrading.

3.4.3 Comprehensive Network Baseline Analysis

Objective – The purpose of Task III is the description and analysis of the USDA Data Network equipment, services, utilization, cost, performance, and survivability.

Rationale – Establishing a network baseline means thoroughly describing the hardware, software, and network characteristics in order to create a reference point for evaluation of new designs. Creating a baseline is fundamental to good engineering practices, is a focus for optimization efforts, and is the reference for insuring the operation of the TEN at a level appropriate to each Agency's mission requirements.

Concept of Methods – Baseline information – network equipment, services used, usage, cost, performance, and survivability – is “discovered” electronically using NetMaker XA[®] to poll network equipment. Network hardware and its usage are described in the Physical Baseline and Network Application Traffic reports. Performance is characterized by the amount of delays experienced by data transfer; fewer delays generally indicate better network design and equipment. Network cost is defined as a cost metric, which includes information about recurring monthly usage, and maintenance as well as the cost of purchased equipment. A lower cost metric for a particular network design reflects reduction in one or more of the cost factors due to such things as link sharing, higher quality equipment, and collective purchasing practices.

Results

- USDA Network router software is out-of-date. Only 13% of the USDA routers use software that is fully supported by the Vendor.
- USDA Data Networks are underutilized. On an “average” day nearly 80% of the circuits are used at less than 10% of theoretical capacity.
- The Baseline Study reveals that most Agency services are independently contracted. Development of the Initial Enterprise Network will consolidate network services contracting and thus gain benefits from economy of scale. Benefits of pooled resources include reduced cost, better performance, and better reliability.

- The Network Cost Metric for the existing USDA Data Networks is \$1.26M per month. Eighty percent of the total is recurring Monthly Cost of Services
- Most USDA Data Network topologies are Agency specific, with network configurations converging on central locations. This configuration does not effectively support shared agency connections. City-to-city consolidation, without re-engineering of WAN networks, causes problems in network capacity, performance, and reliability.

3.4.4 Applications Level Network Traffic Study

Objective – The Network Application Level Traffic Study determines the type and volume of network applications used on the present USDA Data Networks, and assesses network performance and survivability.

Rationale – Traffic studies are performed at two levels:

- Total traffic measurement (Section 3.4.2) is necessary to assess the efficiency of current network utilization patterns and trends.
- Network application traffic defines the network applications being used and the amount of resource they consume relative to Agency requirements.

Both traffic measurements are important network attributes affecting TEN design.

Concept of Methods – Measurement of network application traffic requires the special capabilities of another telecommunications tool—Network Associate's Sniffer Network Analyzer (NA Analyzer). The NA Analyzer, when strategically connected to the USDA Data Network, can determine the type and volume of applications transmitted between selected network locations.

Results

- The predominant use of the current USDA Data Networks is World Wide Web browsing on the Internet
- USDA Data Center traffic is currently not a large percentage of the existing IP networks traffic.
- Performance on the USDA Data Network is generally poor due to constraints imposed by existing design topologies.

- Survivability of the current USDA Data Networks is poor due to constraints of the existing design topologies.
- There is now a sufficient description of the present USDA Data Networks available to design TEN alternatives for management evaluation.
- The TEN baseline description indicates that the USDA Data Networks can be significantly improved by a redesign of the existing networks using a more robust design strategy.
- Redesign of the combined USDA Networks will have the biggest impact on cost.

3.5 Alternative Network Designs

3.5.1 Development of Network Capacity Design

Objective – The Network Capacity Study is a network optimization study that assesses, independently of network topology and mission requirements, the appropriateness of USDA Agency links.

Rationale – The network link sizing metric, indicating the volume of link traffic, is a complex function. When a link is under-utilized, cost is the primary optimizing criterion since money is spent on unnecessary link bandwidth. At peak periods of utilization, the driving principle of link optimization is performance since an over-utilized link is operating at reduced performance. To properly assess link optimization, a metric was developed that relates average and peak usage with a network application priority.

Concept of Methods – Network traffic is the data transferred between two WAN nodes. WAN links interconnect geographically distant LANs. Since routers connect WANs, they record traffic information in their MIB – time of day, transmission start/stop, and amount of information transferred. Routers may be “asked” by NetMaker XA[®] to share traffic information. The data is organized and used for calculation of the link utilization metric.

Results

- Based on average and peak utilization information 100% of the measured USDA Data Network links are, to some degree, incorrectly sized.
- Approximately 84% of the measured USDA Data Network links have an average usage at less than 15% of the theoretical link capacity and represent links on which cost can be reduced.

- Approximately 16% of the existing USDA Data Network links have an average usage greater than 50% of theoretical capacity and require timely attention to avoid an impact on mission performance. (4% are used at >70%, requiring immediate attention.)
- Downgrading (reducing bandwidth) of underutilized network links can potentially reduce USDA service cost by as much as 23%.
- Upgrading (increasing bandwidth) of over-utilized network links can improve service performance for several USDA Agencies.

3.5.2 Development of Alternate Network Designs

Objective – The goal of this study is to present three TEN design alternatives from which the OCIO can choose the direction of continued telecommunications development.

Rationale – Proposing alternate network designs is the culmination of the initial TEN design project. The first five tasks, the bulk of the project activity, established the baseline information about the existing USDA Data Networks and laid groundwork for network design alternatives. The alternative designs developed are “Low Cost” (Fig 6), “Intermediate Cost” (Fig 7), and “Same Cost” (Fig 8) where cost is relative to the existing USDA Data Networks. Network survivability is improved in the “Intermediate Cost” and “Same Cost” designs. The primary distinguishing criterion is cost. In all designs, network performance is the same or better relative to the USDA Data Networks Baseline information.

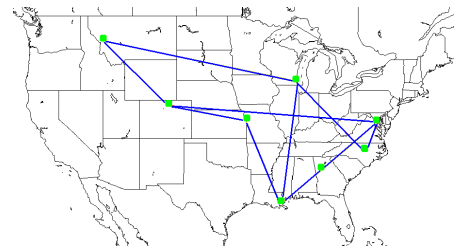


Figure 6 "Low Cost" TEN Design Alternative

Concept of Methods – Using measured USDA Data Networks Baseline information, NetMaker XA[®] Design tool is capable of designing and evaluating custom telecommunications networks. Design constraints imposed on NetMaker XA[®] results are cost and performance. The designs with equal or better performance were sorted to yield, relative to existing USDA Data Networks, low, medium, and same cost alternatives.

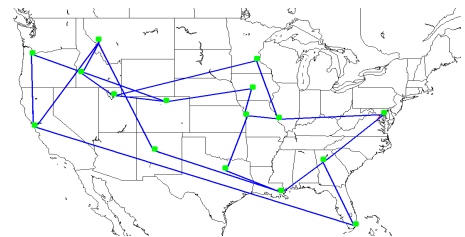


Figure 7 "Intermediate Cost" TEN Design Alternative

Results

- All Design Alternatives perform better than the current USDA Data Network.
- The Network Baseline monthly cost can be reduced by as much as 47% with the new designs.
- Alternative Network Designs can reduce active bandwidth 98% while bandwidth utilization is doubled.



Figure 8 Recommended - "Same Cost" TEN Design Alternative

Completion of the Alternate Design

Task proposes three TEN alternative designs. The "Same Cost" design (Fig. 8), based on superior performance, survivability characteristics, and growth potential, is the recommended design of the three proposals.

The "Intermediate Cost" design represents the continuum of options available by adjusting performance, survivability, and cost.

3.5.3 TEN Economic Analysis

A major factor in the process to select a USDA Design Alternative for implementation is a cost-benefit and economic analysis. The financial analysis of the TEN represents Project Volume Three of the Network Design Series. The objective of this task is to provide USDA management with

- an independent validation (IV&V) of the baseline cost metric;
- an assessment and analysis of current non-recurring and recurring network costs to include equipment, software, services, and personnel; and
- a comparison of potential cost avoidance and/or savings associated with the TEN design alternatives.

The cost-benefit analysis and economic analysis will establish an initial baseline to measure cost and benefits of the TEN project and will be one factor in the decision process to proceed with the TEN project.

3.6 TEN Validation

3.6.1 Independent Verification and Validation

The validation of the TEN Project represents Project Volume Four. The IV&V provides an independent project management review of the TEN project. The document reviews, analyzes and validates planning, requirements, conceptual design, project management, and initial project deliverables.

The review assists the CIO in verifying that the project is focused on the problem, is being executed in the best way possible, and has a high probability of success. It also increases the confidence level of the Department and the oversight agencies.

4.0 Appendix

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